

EXHIBIT A

US005679977A

United States Patent [19]**Khandros et al.**[11] **Patent Number:** **5,679,977**[45] **Date of Patent:** ***Oct. 21, 1997**[54] **SEMICONDUCTOR CHIP ASSEMBLIES,
METHODS OF MAKING SAME AND
COMPONENTS FOR SAME**[75] **Inventors:** **Igor Y. Khandros, Peekskill; Thomas
H. Distefano, Bronxville, both of N.Y.**[73] **Assignee:** **Tessera, Inc., San Jose, Calif.**[*] **Notice:** The term of this patent shall not extend
beyond the expiration date of Pat. No.
5,148,266.[21] **Appl. No.:** **30,194**[22] **Filed:** **Apr. 28, 1993****Related U.S. Application Data**[63] Continuation-in-part of Ser. No. 586,758, Sep. 24, 1990, Pat.
No. 5,148,266, and Ser. No. 673,020, Mar. 21, 1991, Pat.
No. 5,148,265, and a continuation of Ser. No. 765,928, filed
as PCT/US91/06920, Sep. 24, 1991, Pat. No. 5,347,159.[51] **Int. Cl.** **H01L 23/48; H01L 23/52**[52] **U.S. Cl.** **257/692; 257/701; 257/690**[58] **Field of Search** **257/701, 702,
257/703, 698, 693, 692, 690**[56] **References Cited****U.S. PATENT DOCUMENTS**

1955,008	2/1977	Gregor et al.
3,302,067	1/1967	Jackson et al.
3,390,308	6/1968	Marley
3,426,252	2/1969	Lepselter
3,474,297	10/1969	Bylander

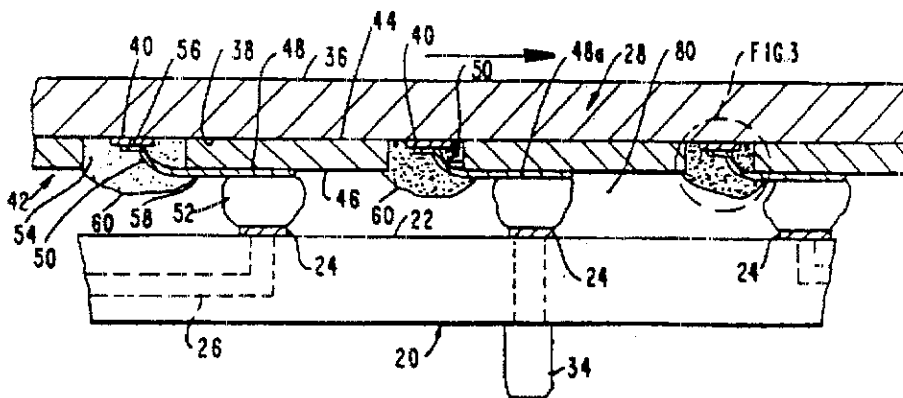
FOREIGN PATENT DOCUMENTS

072673	8/1982	European Pat. Off.
080041	9/1982	European Pat. Off.
413451	7/1990	European Pat. Off.
2405839	12/1981	France
2495839	12/1981	France

(List continued on next page.)

OTHER PUBLICATIONSIBM Technical Disclosure Bulletin entitled "Non-Perma-
nent Mounting Technique For Test and Burn-In of C4
Devices", Nov. 1990, vol. 33, No. 7.IBM Technical Disclosure Bulletin, entitled "Extended Pad
For Testing Package Parts", Dec. 1984, vol. 27, No. 7B.IBM Technical Disclosure Bulletin entitled "Test And
Repair of Direct Chip Attach Modules", Aug. 1988, vol. 31,
No. 3."Design For Minimum Chip Joint Stress", IBM Technical
Disclosure Bulletin, vol. 32, No. 7, Dec. 1989."Improved C4 Reliability Using Low Modulus Dielectric
Layer", IBM Technical Disclosure Bulletin, vol. 32, No. 6A,
Nov. 1989.Nitto Product Information, "New Tab Mounting Method".
IBM Technical Disclosure Bulletin, Jan. 1985, vol. 27, No.
8, p. 4855.IBM Technical Disclosure Bulletin, "Non-Permanent
Mounting Technique for Test and Burn-In of C4 Devices",
Nov. 1990, vol. 33, No. 7.IBM Technical Disclosure Bulletin, "Extended Pad for Test-
ing Package Parts", Dec. 1984, vol. 27, No. 7B pp.,
4210-4211.IBM Technical Disclosure Bulletin, "Test and Repair of
Direct Chip Attach Modules", Aug. 1988, vol. 31, No. 3.Microelectronics Packaging Handbook, 1989, pp. 420-423,
1132, Rao R. Tummala and Eugen J. Rymaszewski.*Primary Examiner*—Mahshid D. Saadat*Assistant Examiner*—Sheila Clark*Attorney, Agent, or Firm*—Lerner, David, Littenberg,
Krumholz & Mentlik[57] **ABSTRACT**

Semiconductor chip assemblies incorporating flexible, sheet-like elements having terminals thereon overlying the front or rear face of the chip to provide a compact unit. The terminals on the sheet-like element are movable with respect to the chip, so as to compensate for thermal expansion. A resilient element such as a compliant layer interposed between the chip and terminals permits independent movement of the individual terminals toward the chip driving engagement with a test probe assembly so as to permit reliable engagement despite tolerances.

27 Claims, 19 Drawing Sheets

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U.S. PATENT DOCUMENTS

3,487,541	1/1970	Boswell	4,842,662	6/1989	Jacobi
3,611,061	10/1971	Segerson	4,847,146	7/1989	Yeh et al.
3,614,832	10/1971	Chance et al.	4,855,867	8/1989	Gazdik et al.
3,680,037	7/1972	Nellis et al.	4,855,872	8/1989	Wojnar et al.
3,680,206	8/1972	Roberts	4,860,088	8/1989	Smith et al.
3,683,105	8/1972	Shamash et al.	4,866,841	9/1989	Hubbard
3,689,991	9/1972	Aird	4,874,721	10/1989	Kimura et al.
3,724,068	4/1973	Galli	4,878,098	10/1989	Saito et al.
3,772,575	11/1973	Hegarty et al.	4,884,122	11/1989	Eichelberger et al.
3,795,037	3/1974	Luttmer	4,887,148	12/1989	Mu
3,823,467	7/1974	Shamash et al.	4,893,172	1/1990	Matsumoto et al.
3,832,769	9/1974	Olyphant, Jr. et al.	4,918,811	4/1990	Eichelberger et al.
3,862,790	1/1975	Davies et al.	4,924,353	5/1990	Patraw
3,864,728	2/1975	Peltz et al.	4,926,241	5/1990	Carey
3,868,724	2/1975	Perrino	4,937,203	6/1990	Eichelberger et al.
3,925,404	12/1975	Matunami	4,937,707	6/1990	McBride et al.
4,179,802	12/1979	Joshi et al.	4,941,033	7/1990	Kishida
4,189,825	2/1980	Robillard et al.	4,942,140	7/1990	Ootsuki et al.
4,237,607	12/1980	Ohno	4,954,878	9/1990	Fox et al.
4,349,862	9/1982	Bajorek et al.	4,967,261	10/1990	Niki et al.
4,356,374	10/1982	Noyori et al.	4,975,765	12/1990	Ackermann et al.
4,410,905	10/1983	Grabbe	4,989,069	1/1991	Hawkins
4,437,141	3/1984	Prokop	4,993,954	2/1991	Prevost
4,545,610	10/1985	Lakritz et al.	5,006,673	4/1991	Freyman et al.
4,574,470	3/1986	Burt	5,019,673	5/1991	Juskey et al.
4,597,617	7/1986	Enochs	5,027,191	6/1991	Bourdelaie et al.
4,604,644	8/1986	Beckham et al.	5,029,325	7/1991	Higgins, III et al.
4,627,151	12/1986	Mulholland et al.	5,045,921	9/1991	Lin et al.
4,628,406	12/1986	Smith et al.	5,045,922	9/1991	Kodama et al.
4,649,415	3/1987	Herbert	5,053,922	10/1991	Matta et al.
4,655,524	4/1987	Etzel	5,086,337	2/1992	Noro et al.
4,658,332	4/1987	Baker et al.	5,117,275	5/1992	Bregman
4,667,220	5/1987	Lee et al.	5,123,850	6/1992	Elder et al.
4,670,770	6/1987	Tai	5,136,366	8/1992	Worp et al.
4,681,654	7/1987	Clementi et al.	5,148,265	9/1992	Khandros et al.
4,685,998	8/1987	Quin et al.	5,148,266	9/1992	Khandros et al.
4,695,870	9/1987	Patraw	5,222,014	6/1993	Lin
4,700,473	10/1987	Freyman et al.	5,289,346	2/1994	Carey et al.
4,709,468	12/1987	Wilson	5,347,159	9/1994	Khandros et al.
4,710,798	12/1987	Marcantonio	5,350,947	9/1994	Takekawa et al.
4,721,993	1/1988	Walter	5,379,191	1/1995	Carey et al.
4,751,199	6/1988	Phy	5,414,298	5/1995	Grube et al.
4,751,482	6/1988	Fukuta et al.			
4,764,804	8/1988	Sahara et al.			
4,772,936	9/1988	Reding et al.			
4,783,719	11/1988	Jamison et al.			
4,793,814	12/1988	Zifcak et al.			
4,796,078	1/1989	Phelps, Jr. et al.			
4,811,082	3/1989	Jacobs et al.			
4,814,295	3/1989	Mehta			
4,818,728	4/1989	Rai et al.			

U.S. PATENT DOCUMENTS

2586885	8/1986	France
60-217641	10/1985	Japan
1-155633	6/1989	Japan
1-293528	11/1989	Japan
1003396	3/1983	U.S.S.R.
8910005	10/1989	WIPO
9112706	8/1991	WIPO

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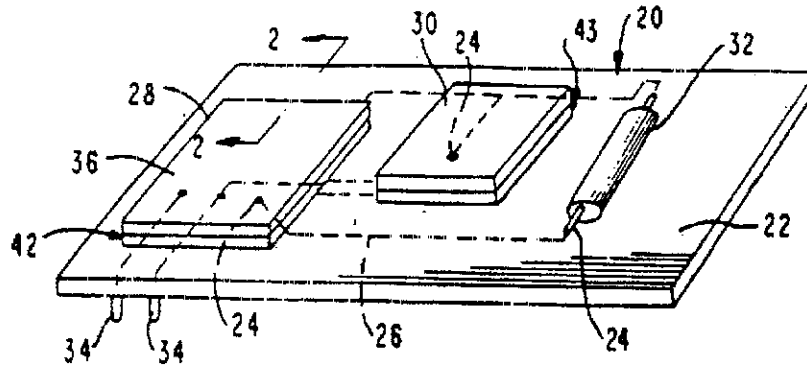


FIG. 1

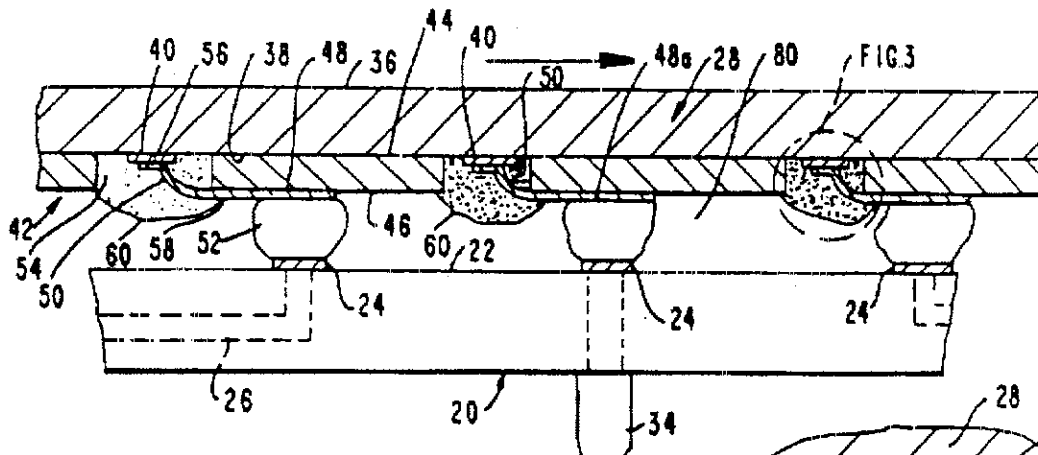


FIG. 2

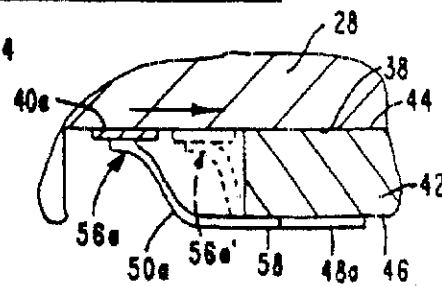


FIG. 3

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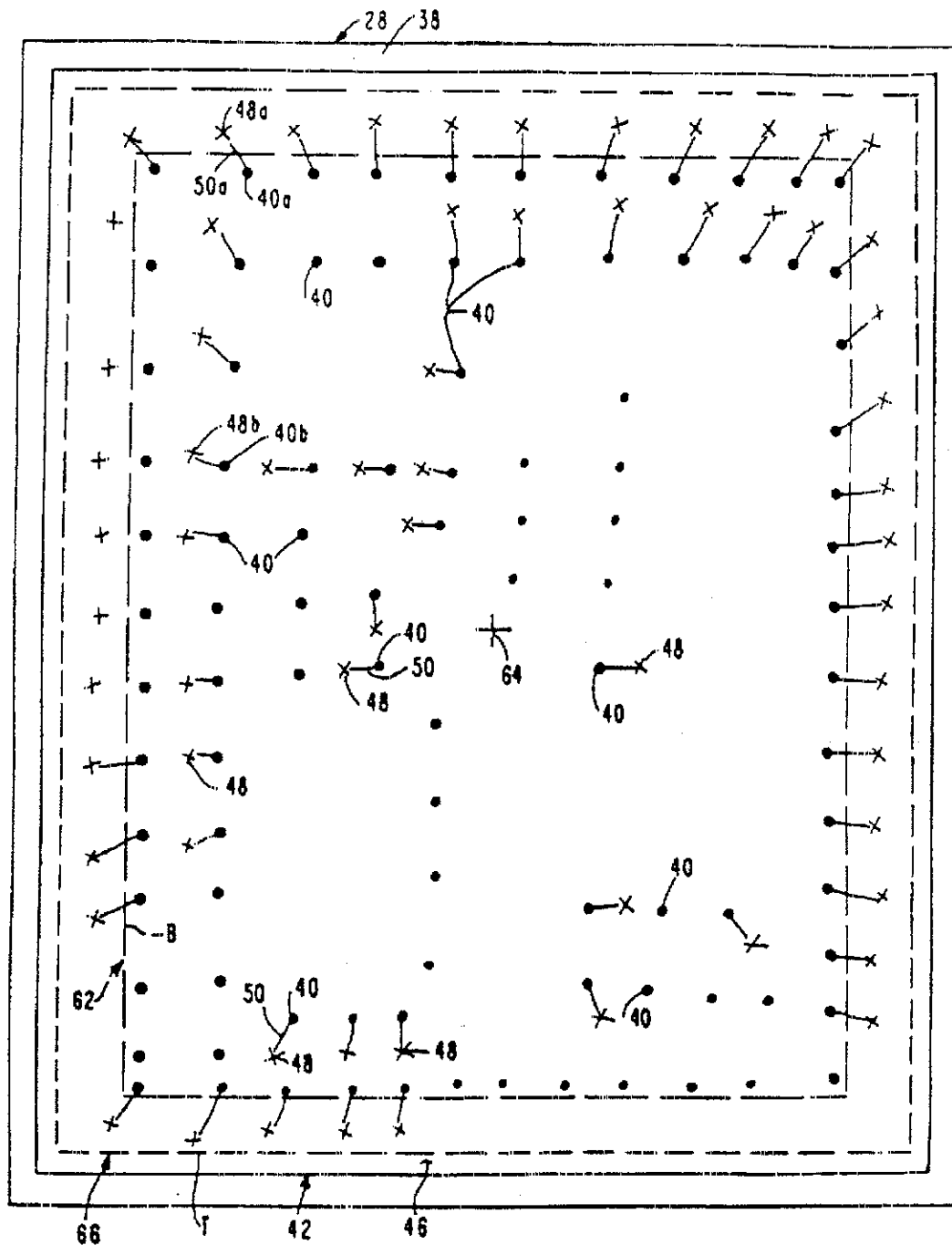


FIG. 4

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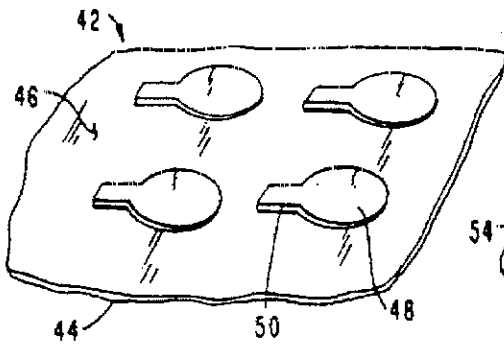


FIG 5A

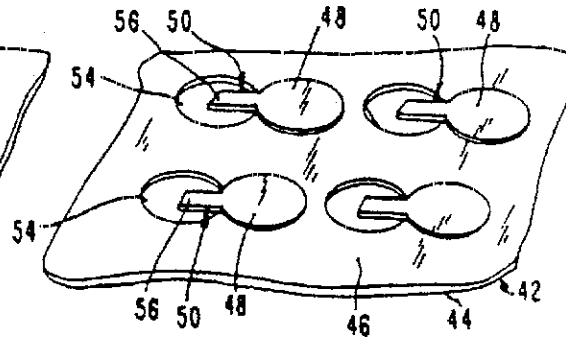


FIG. 5B

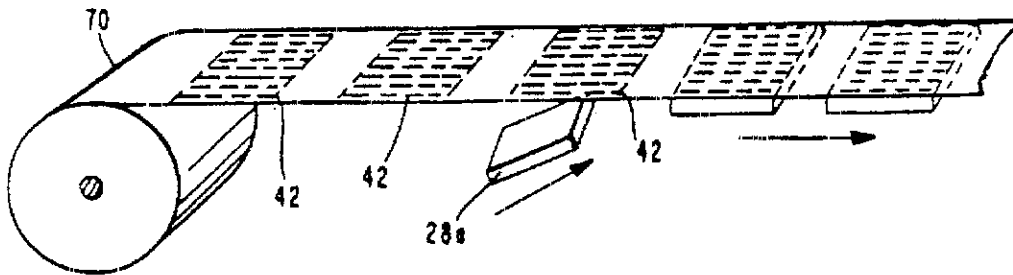


FIG. 6

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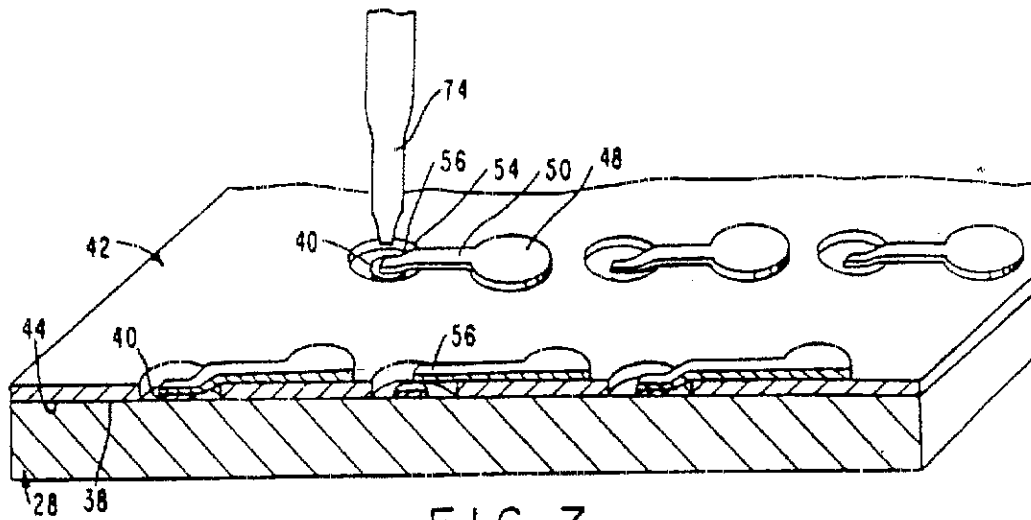


FIG. 7

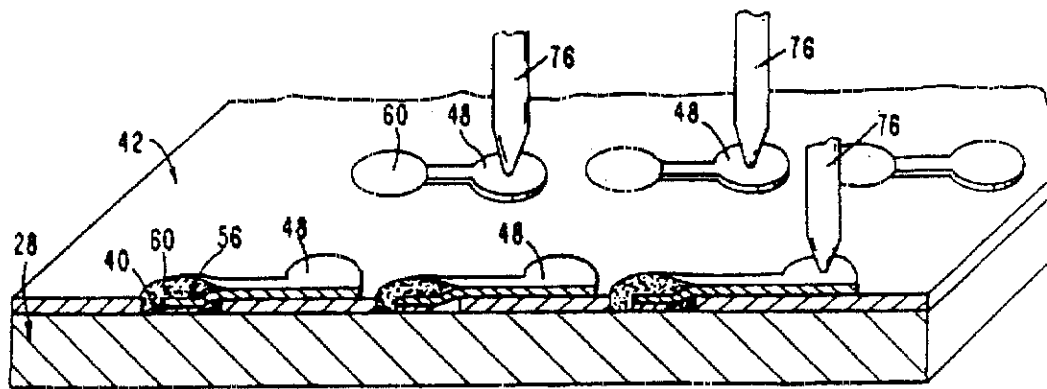


FIG. 8

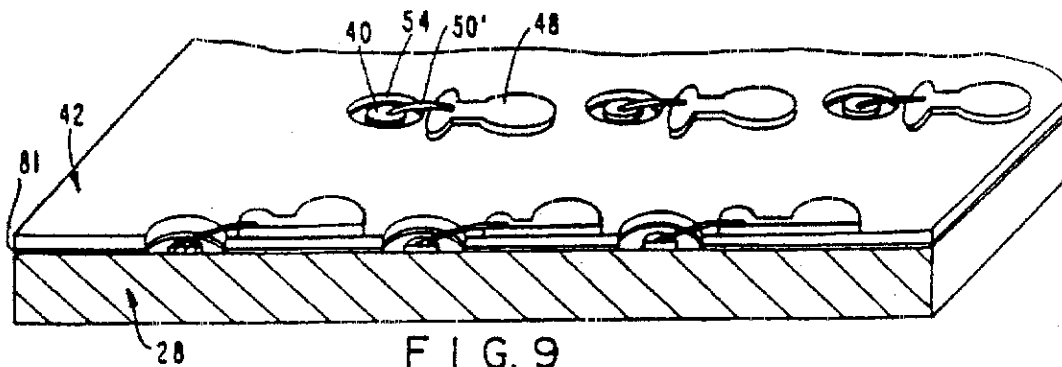


FIG. 9

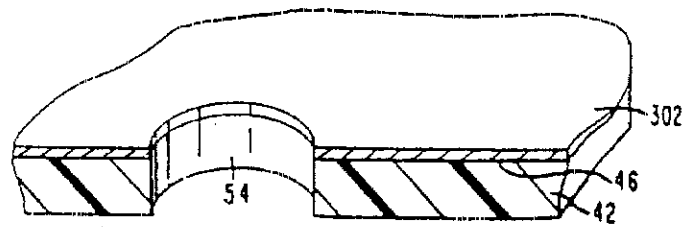


FIG. 10A

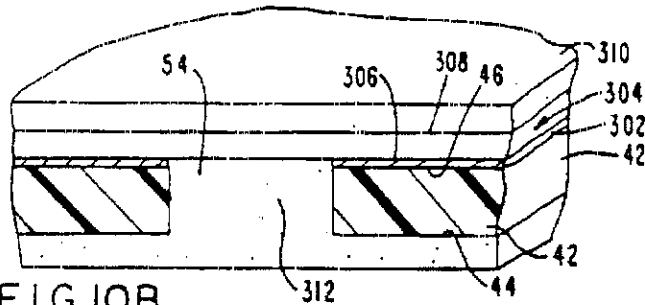


FIG. 10B

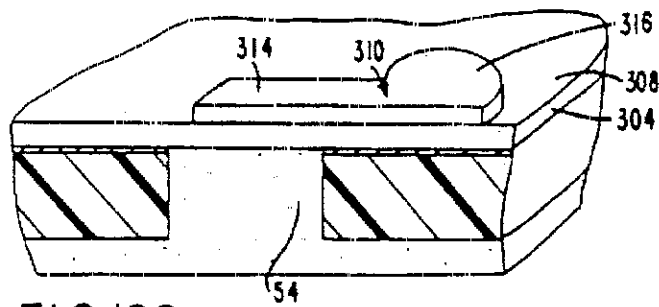


FIG. 10C

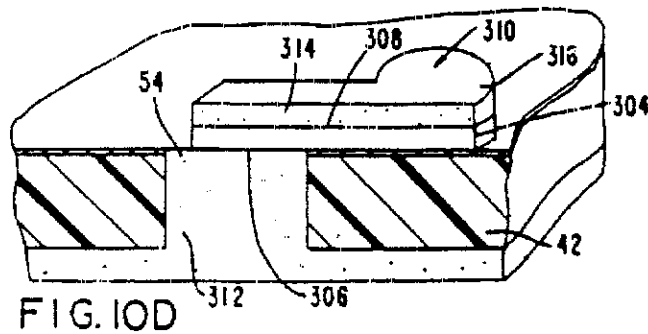


FIG. 10D

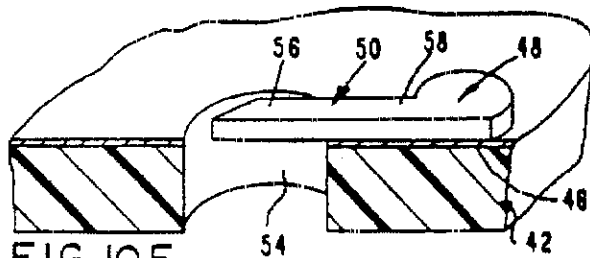


FIG. 10E

FIG. 11

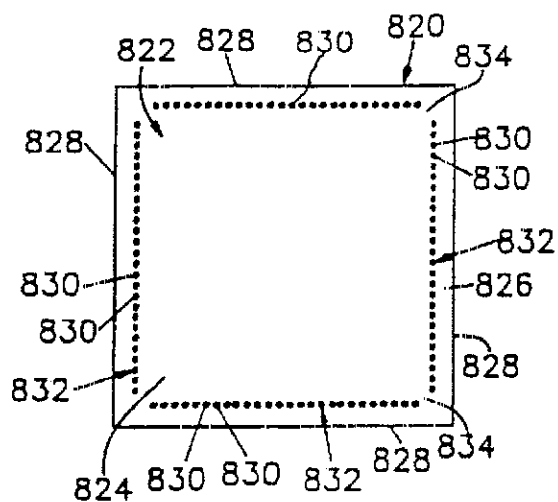


FIG. 12

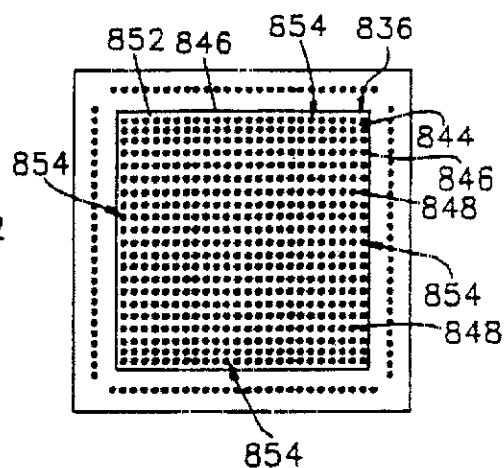


FIG. 17

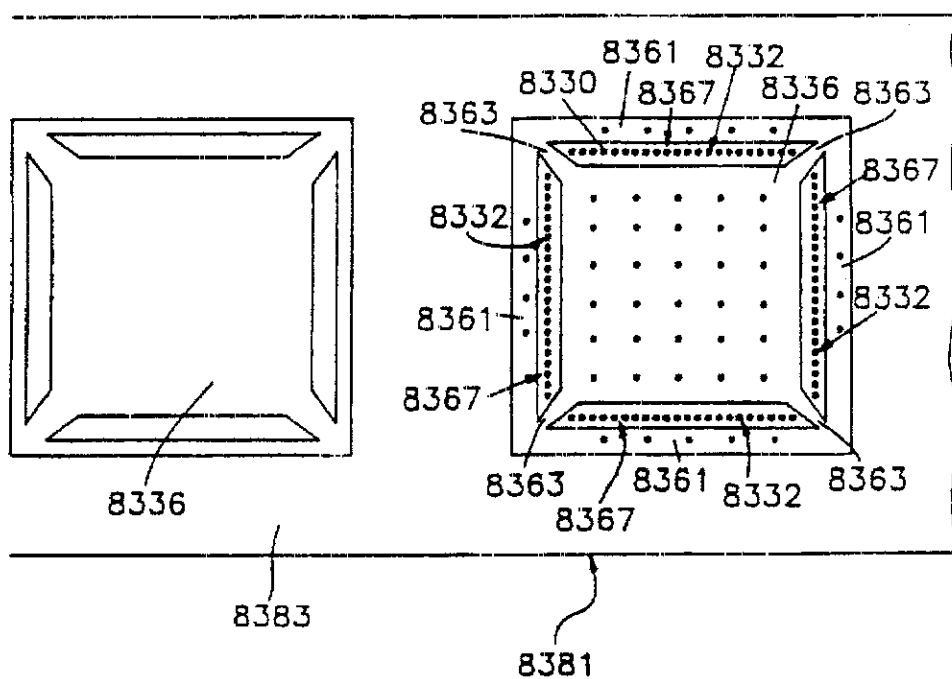


FIG. 13

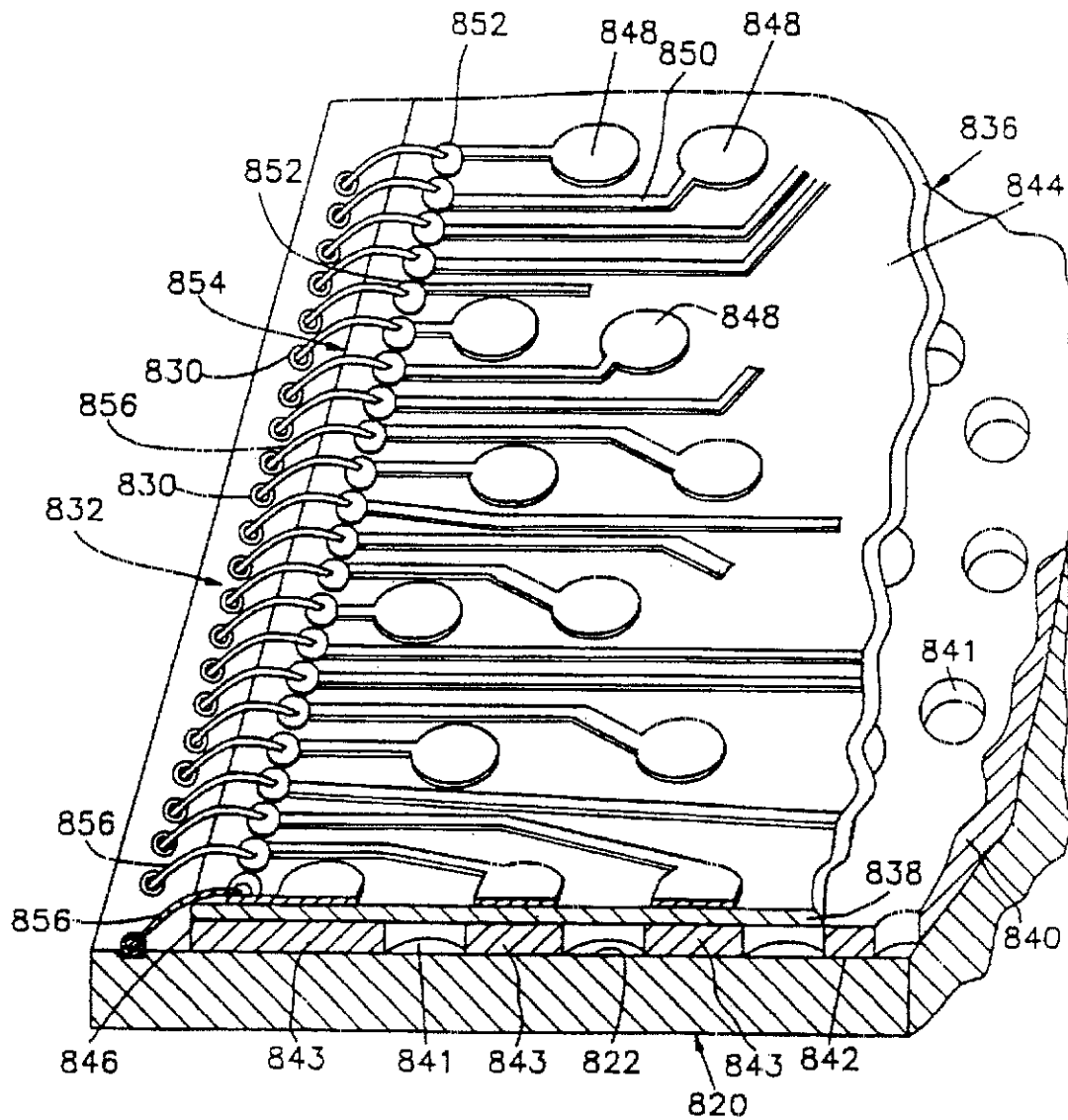


FIG. 14

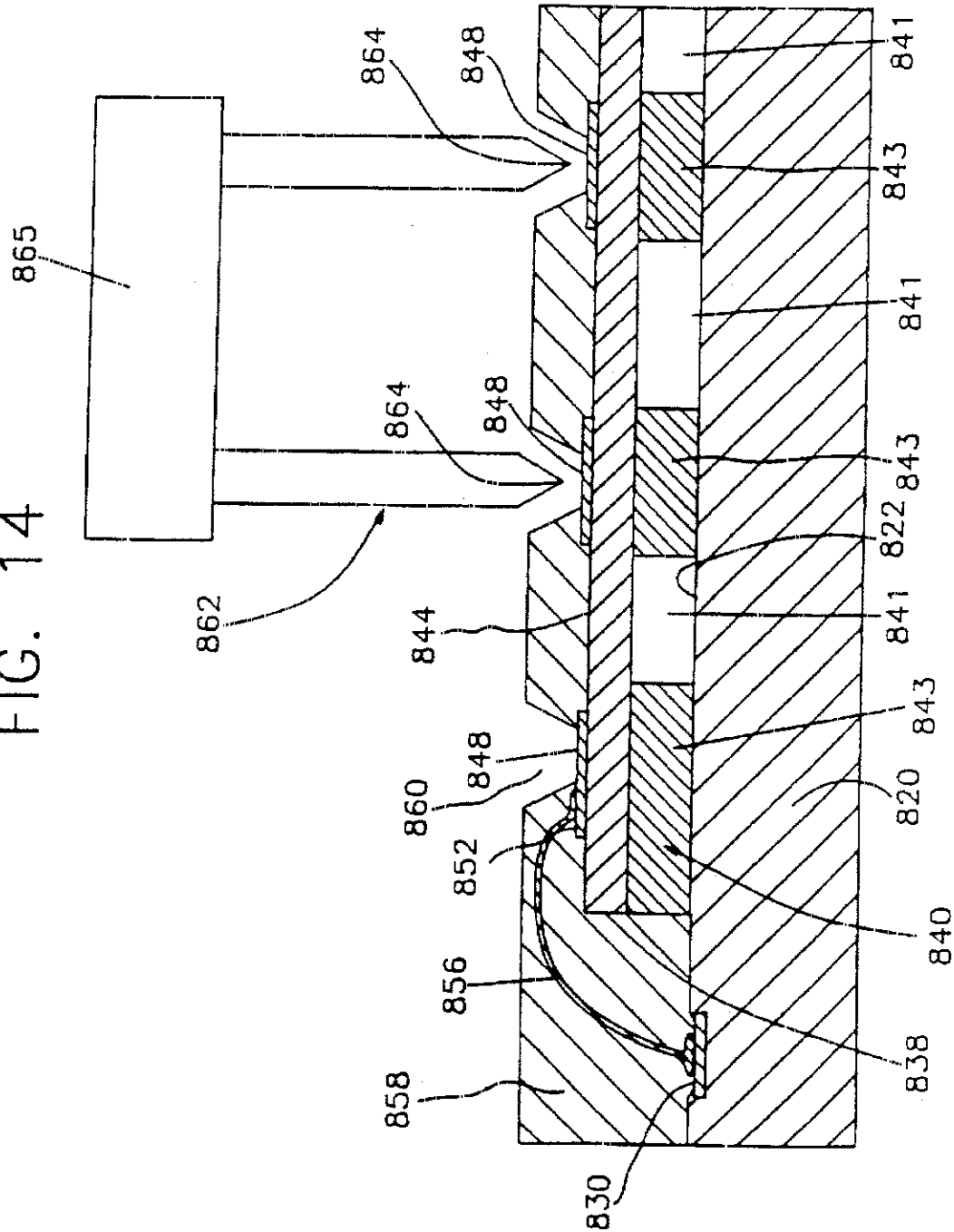
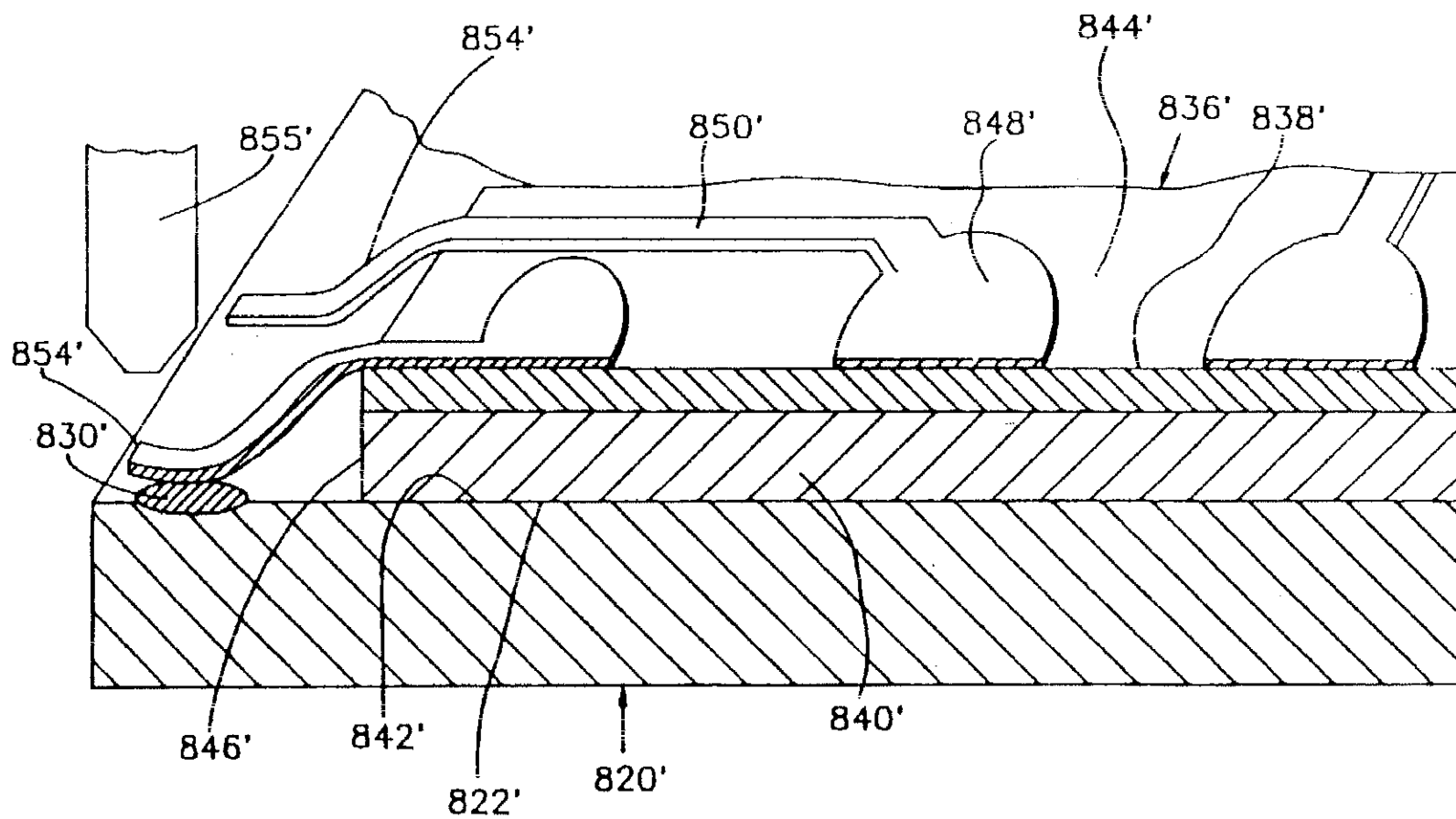


FIG. 15



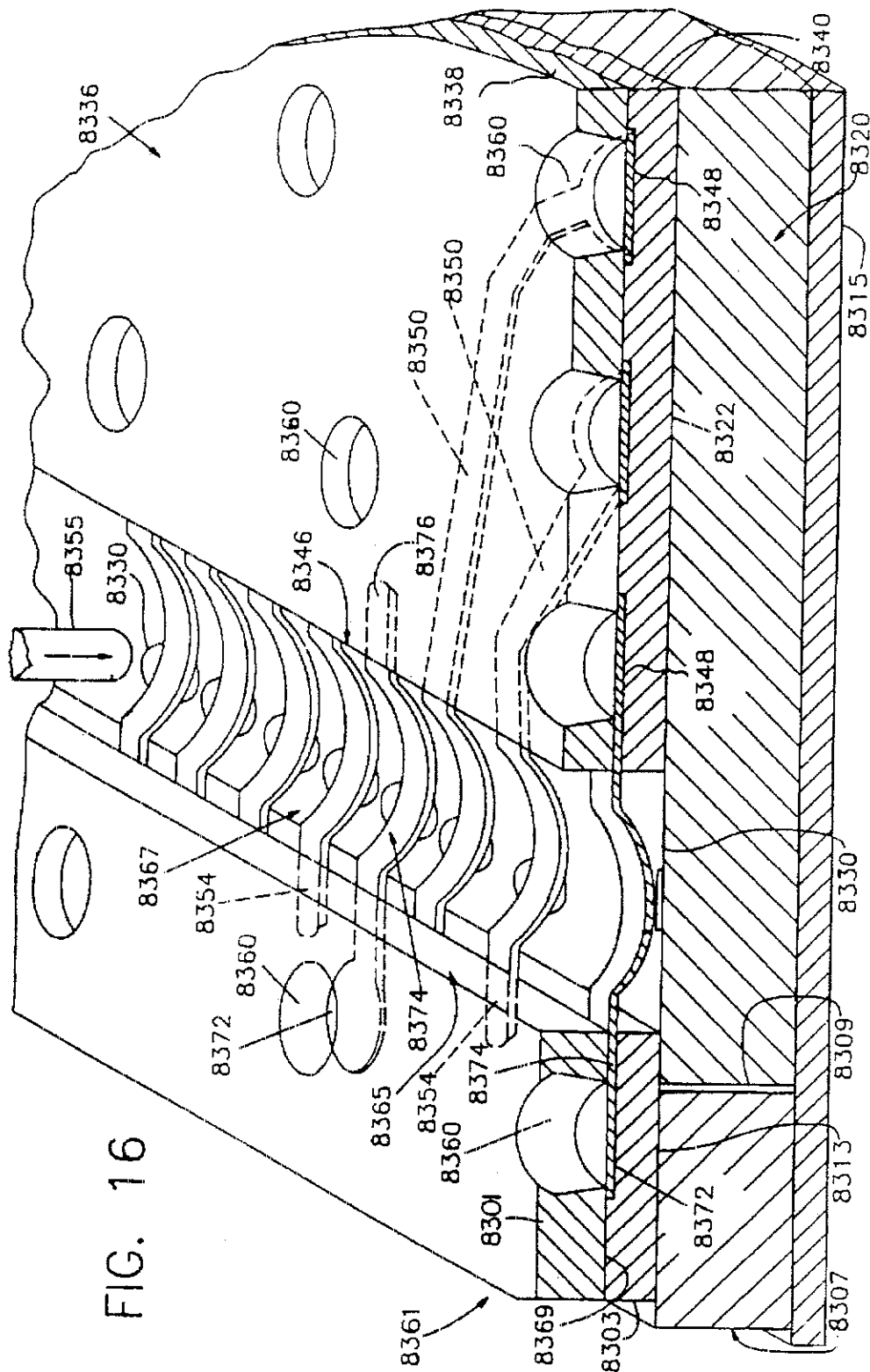
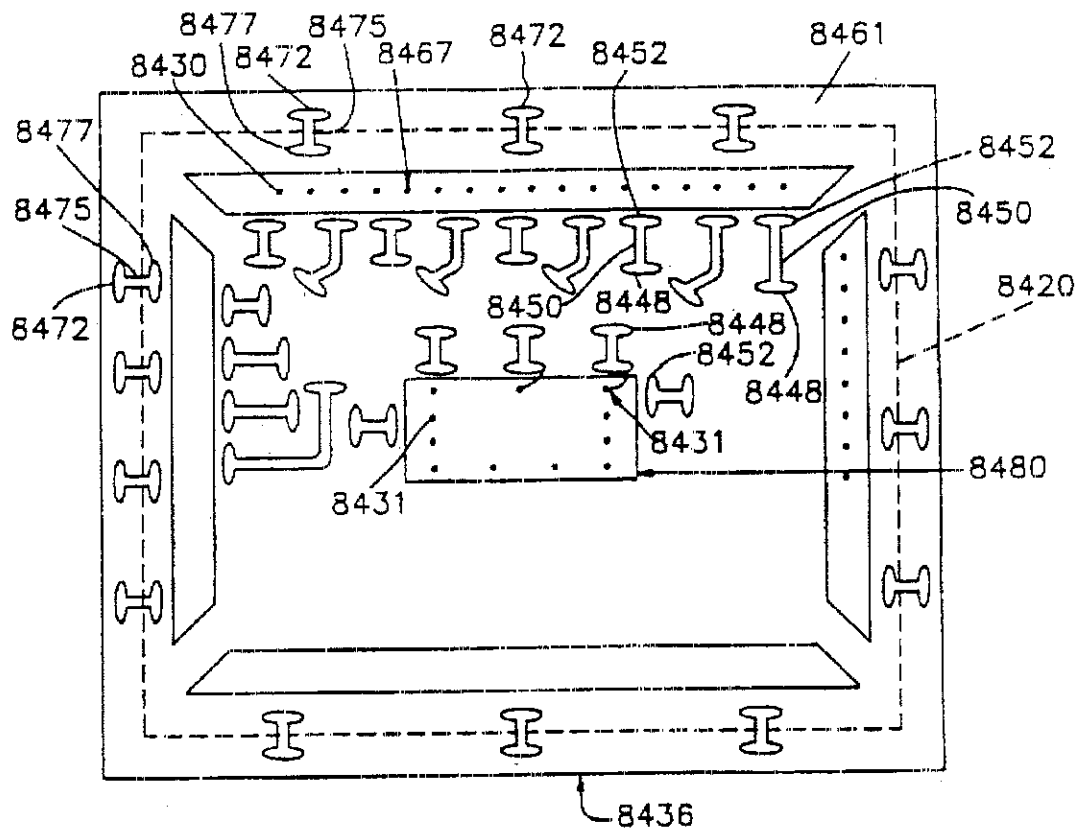


FIG. 16

FIG. 18



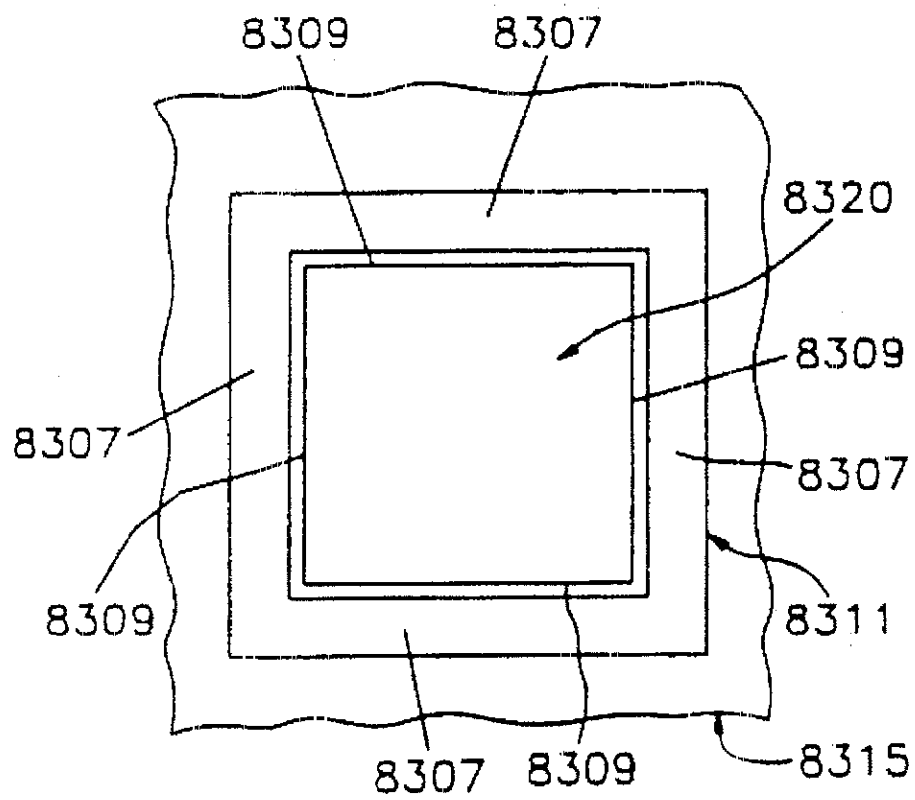
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FIG. 19



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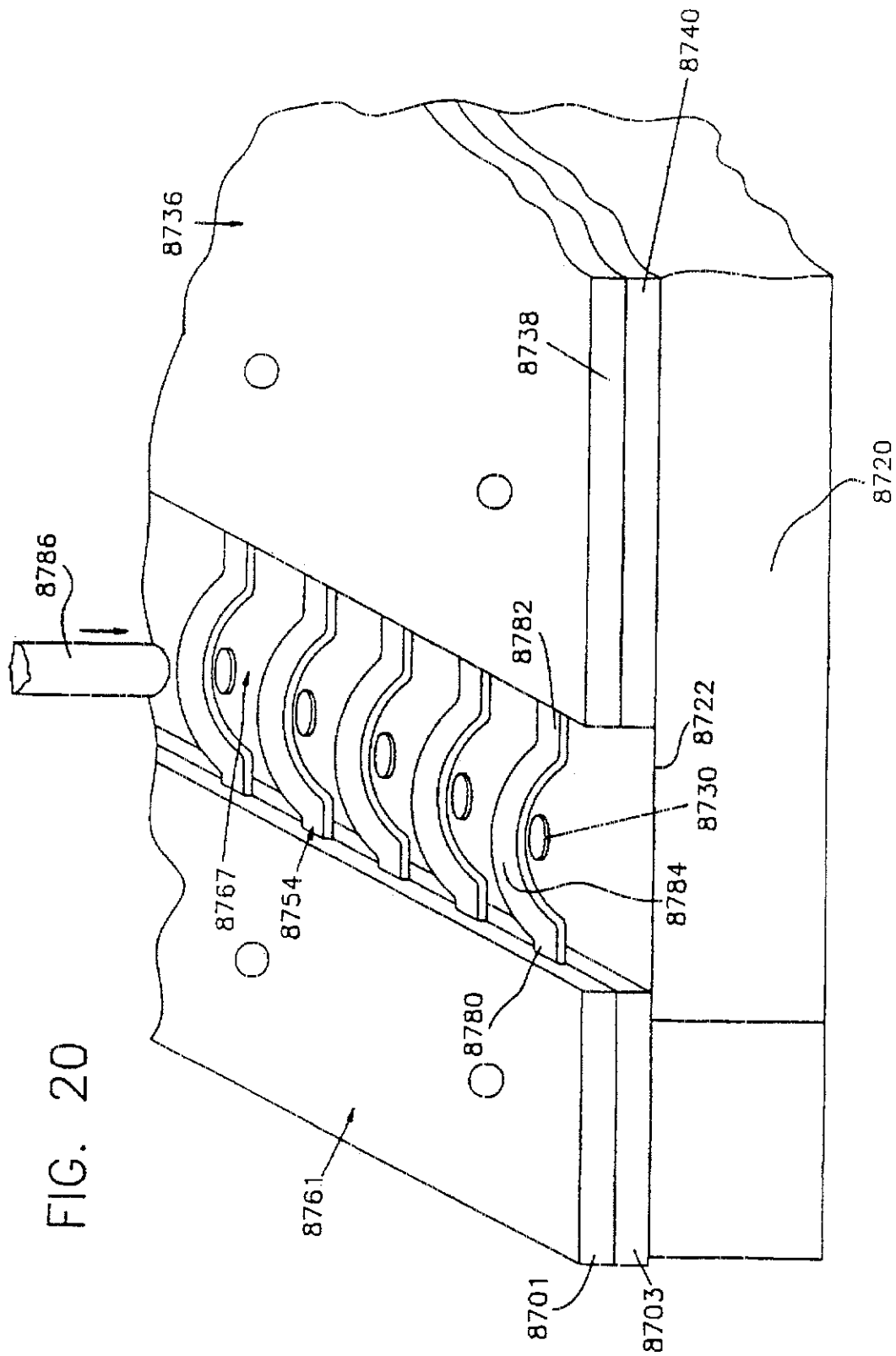


FIG. 21

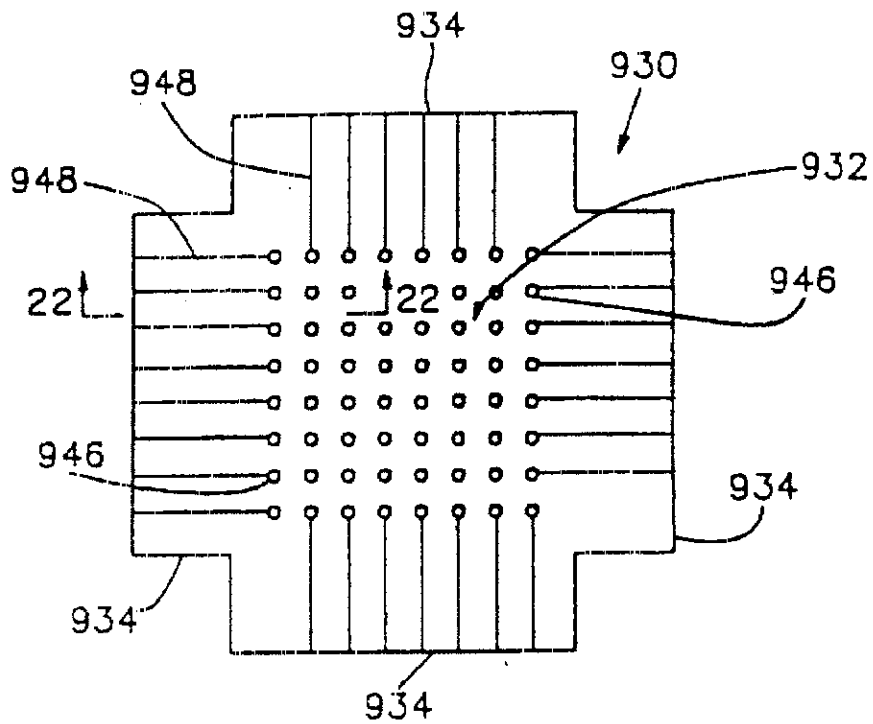


FIG. 22

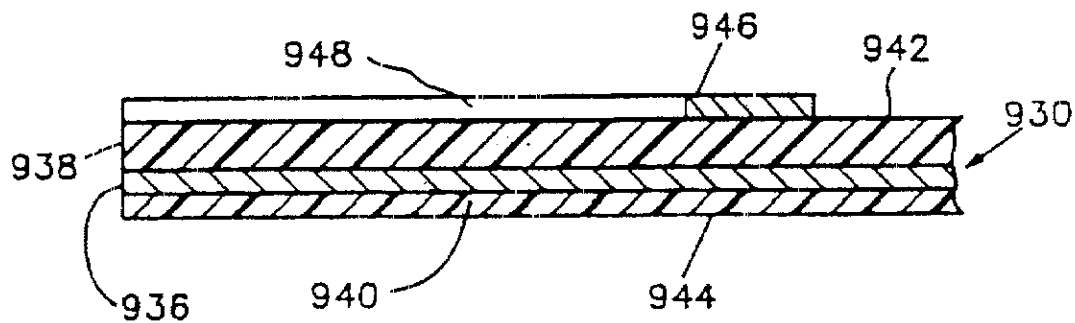


FIG. 23

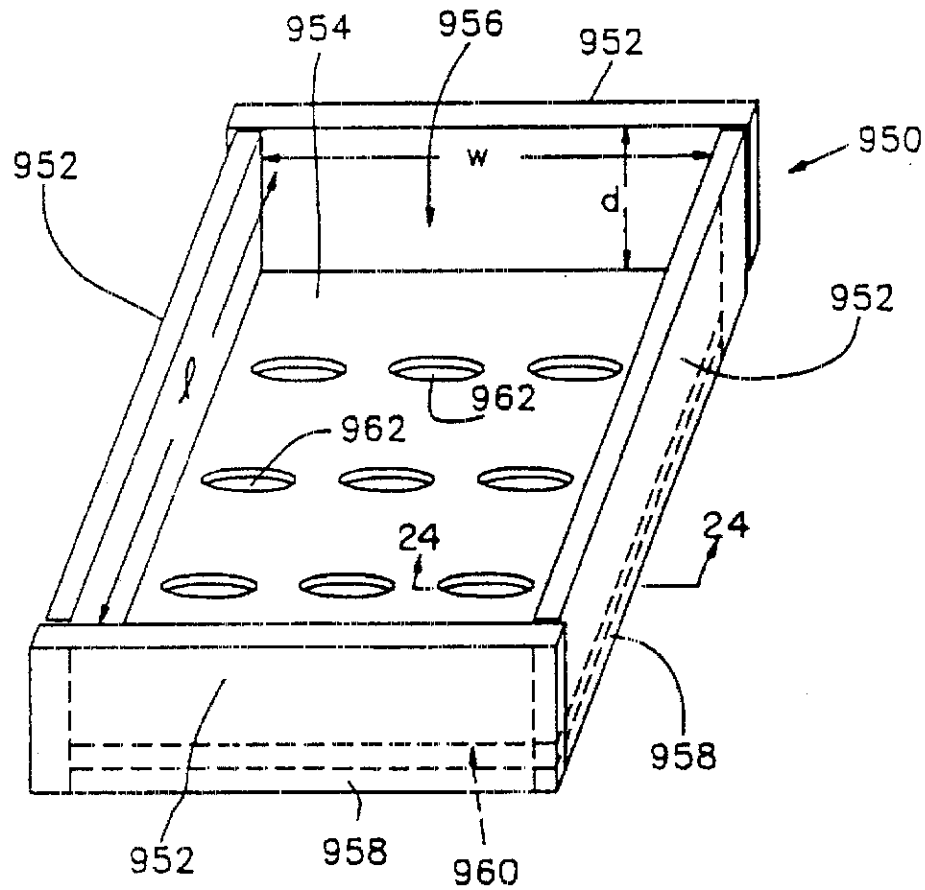


FIG. 24

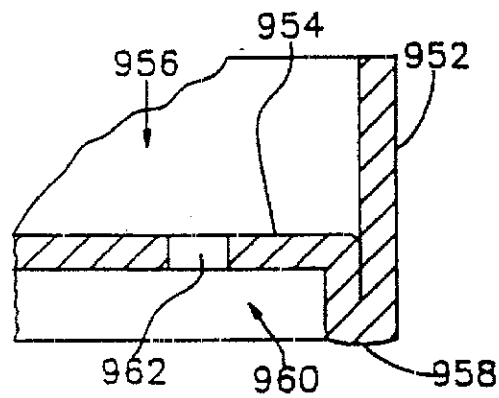


FIG. 25

